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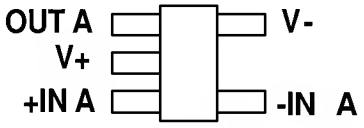
Ultra Low Power Rail-to-Rail Output Operational Amplifier

Preliminary OP186

FEATURES
Low Supply Current: 4 µA Max
Single-Supply Operation: 2.7 to 12 Volts
Wide Input Voltage Range
Rail-to-Rail Output Swing
No Phase Reversal

APPLICATIONS
Comparator
Battery Powered Instrumentation
Safety Monitoring
Remote Sensors
Low Voltage Strain Gage Amplifiers

5-Lead SOT
(RT Suffix)



OP186

GENERAL DESCRIPTION

The OP186 is a single **ultra low power** single-supply, amplifier featuring rail-to-rail outputs. Specified at 3 volt, and **5 volt single supply** as well as ±5 volt dual supplies, it is guaranteed to operate from as low as 2.7 volts.

Fabricated on Analog Device's CBCMOS process, the OP186 features a bipolar input and an output that swings to within millivolts of the supplies and continues to sink or source current all the way to the supplies.

Applications for these amplifiers include safety monitoring, portable equipment, battery and power supply control, and as signal conditioning and interface for transducers in very low power systems.

The output's ability to swing rail-to-rail and not increase supply current when the output is driven to a supply, enables the OP186 to be used as a comparator in very low power systems.

The OP186 is specified over the extended industrial (-40° to +125°C) temperature range. The OP186 is available in the SOT23 package.

REV. 0

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ELECTRICAL SPECIFICATIONS (@ V_S=+3.0V, V_{CM} = 0.1V,T_A=+25°C unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}				4	mV
		-40°≤T_A ≤ +125°C				mV
Input Bias Current	I_B			3.2		nA
		-40°≤T_A ≤ +125°C				nA
Input Offset Current	I_{OS}					nA
		-40°≤T_A ≤ +125°C				nA
Input Voltage Range			0		2	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 to 2.0V				dB
		-40°≤T_A ≤ +125°C				dB
Large Signal Voltage Gain	A_{VO}	R_L = 1MΩ , V_O = 0.3 to 2.7V				V/mV
		-40°≤T_A ≤ +125°C				V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$					µV/°C
Bias Current Drift	$\Delta I_B/\Delta T$					pA/°C
Offset Current Drift	$\Delta I_{OS}/\Delta T$					pA/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 100kΩ to Gnd.	2.95	2.99		V
		-40°C to +125°C	2.90	2.98		V
Output Voltage Low	V_{OL}	R_L = 100kΩ to V+		10		mV
		-40°C to +125°C			35	mV
Short Circuit Limit	I_{SC}			±2		mA
		-40°C to +125°C				mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 2.7V to 12 V				dB
		-40°≤T_A ≤ +125°C				dB
Supply Current/Amplifier	I_{SY}	-40°≤T_A ≤ +125°C		4		µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L =100 kΩ, C_L = 50pF		28		V/ms
Turn On Time		A_V = 1, V_O = 1				µs
Turn On Time		A_V = 20, V_O = 1				µs
Settling Time	t_s	To 0.01%				µs
Gain Bandwidth Product	GBP					kHz
Phase Margin	Øo					degrees
NOISE PERFORMANCE						
Voltage Noise	$e_{n\ p\text{-}p}$	0.1 to 10 Hz				$\mu V_{p\text{-}p}$
Voltage Noise Density	e_n	f = 1kHz		110		nV/√Hz
Current Noise Density	i_n					pA/√Hz

ELECTRICAL SPECIFICATIONS (@ V_S=+5.0V, V_{CM} = 0.1V,T_A=+25°C unless otherwise noted. Note 1)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	Note 2			4	mV
		-40°≤T_A ≤ +125°C			1.0	mV
Input Bias Current	I_B			3.2		nA
		-40°≤T_A ≤ +125°C				nA
Input Offset Current	I_{OS}			0.1	8	nA
		-40°≤T_A ≤ +125°C			16	nA
Input Voltage Range			0		4	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 to 4.0V	76			dB
		-40°≤T_A ≤ +125°C	76			dB
Large Signal Voltage Gain	A_{VO}	R_L = 1 MΩ , V_O = 0.5 to 4.5V				V/mV
		-40°≤T_A ≤ +125°C				V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	-40°≤T_A ≤ +125°C				µV/°C
Bias Current Drift	$\Delta I_B/\Delta T$					pA/°C
Offset Current Drift	$\Delta I_{OS}/\Delta T$					pA/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 100kΩ to Gnd.	4.95	4.99		V
		-40°C to +125°C	4.90	4.98		V
Output Voltage Low	V_{OL}	R_L = 100kΩ to V+,		4.5	10	mV
		-40°C to +125°C			35	mV
Short Circuit Limit	I_{SC}			±2		mA
		-40°C to +125°C				mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 2.7V to 12V	76	96		dB
		-40°≤T_A ≤ +125°C	76	95		dB
Supply Current/Amplifier	I_{SY}	-40°≤T_A ≤ +125°C		3.5		µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 100 kΩ, C_L = 50pF		26		V/ms
Gain Bandwidth Product	GBP					kHz
Phase Margin	Øo					degrees
NOISE PERFORMANCE						
Voltage Noise	$e_{n\,p\text{-}p}$	0.1 to 10 Hz				$\mu V_{p\text{-}p}$
Voltage Noise Density	e_n	f = 1 kHz		110		nV/√Hz
Voltage Noise Density	e_n	f = 10 kHz				nV/√Hz
Current Noise Density	i_n					pA/√Hz

NOTE 1: +5 volt specifications are guaranteed by +3 and ±5 volt testing.
Note 2: V_{OS} is tested under a no load condition.

ELECTRICAL SPECIFICATIONS (@ V_S = ±5V, T_A=+25°C unless otherwise noted.)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}				4	mV
		-40°≤T_A ≤ +125°C				mV
Input Bias Current	I_B			3.2		nA
		-40°≤T_A ≤ +125°C				nA
Input Offset Current	I_{OS}			0.1	8	nA
		-40°≤T_A ≤ +125°C			16	nA
Input Voltage Range			-5		+4	V
Common-Mode Rejection	CMRR	V_{CM} = -5.0 to +4.0V	75			dB
		-40°≤T_A ≤ +125°C	67			dB
Large Signal Voltage Gain	A_{VO}	R_L = 1 MΩ , V_O = ±4.0V, -40°≤T_A ≤ +125°C		6.5		V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$					µV/°C
Bias Current Drift	$\Delta I_B/\Delta T$					pA/°C
Offset Current Drift	$\Delta I_{OS}/\Delta T$					pA/°C
OUTPUT CHARACTERISTICS						
Output Voltage Swing	V_O	R_L = 100kΩ to Gnd.	±4.93	±4.99		V
		-40°C to +125°C	±4.90	±4.98		V
Short Circuit Limit	I_{SC}					mA
		-40°C to +125°C				mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = ±25.V to ±6V	76			dB
		-40°≤T_A ≤ +125°C	70			dB
Supply Current/Amplifier	I_{SY}	V_O = 0V		3.3	5	µA
		-40°≤T_A ≤ +125°C				µA
DYNAMIC PERFORMANCE						
Slew Rate	±SR	R_L = 100 kΩ, C_L = 50pF		35		V/ms
Saturation Recovery Time						ms
Gain Bandwidth Product	GBP			58		kHz
Phase Margin	Øo			56		degrees
NOISE PERFORMANCE						
Voltage Noise	$e_{n\,p-p}$	0.1 to 10 Hz				μV_{p-p}
Voltage Noise Density	e_n	f = 1kHz		110		nV/√Hz
Voltage Noise Density	e_n	f = 10kHz		80		nV/√Hz
Current Noise Density	i_n					pA/√Hz

ABSOLUTE MAXIMUM RATINGS

Supply Voltage ..... +16V
Input Voltage ..... Gnd to Vs+10V
Differential Input Voltage ..... ±3.5V
Output Short-Circuit Duration to Gnd[1] ..... Indefinite
Storage Temperature Range
RT Package ..... -65°C to +150°C
Operating Temperature Range
OP186G ..... -40°C to +125°C
Junction Temperature Range
RT Package ..... -65°C to +150°C
Lead Temperature Range (Soldering, 60 sec.) ..... +300°C

Package Type	θ_{JA}[1]	θ_{JC}	Units
5-Lead SOT23 (RT)			°C/W

NOTES
[1] θ_{JA} is specified for the worst case conditions, i.e., θ_{JA} is specified for device soldered in circuit board for SOT packages.

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
OP186GRT	-40°C to +125°C	5-Lead SOT23	RT-5